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(54) **SURGICAL TABLE**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,202,218 A 8/1965 Watts et al.
3,238,539 A 3/1966 Koch
3,584,321 A * 6/1971 Buchanan 5/601
(Continued)

OTHER PUBLICATIONS

Allen Medical Systems, "Intraoperative Adjustment from Kyphosis to Lordosis", Announcement Allen Medical Systems, Feb. 6, 2006, pp. 1-4.

(Continued)

Primary Examiner — David E Sosnowski

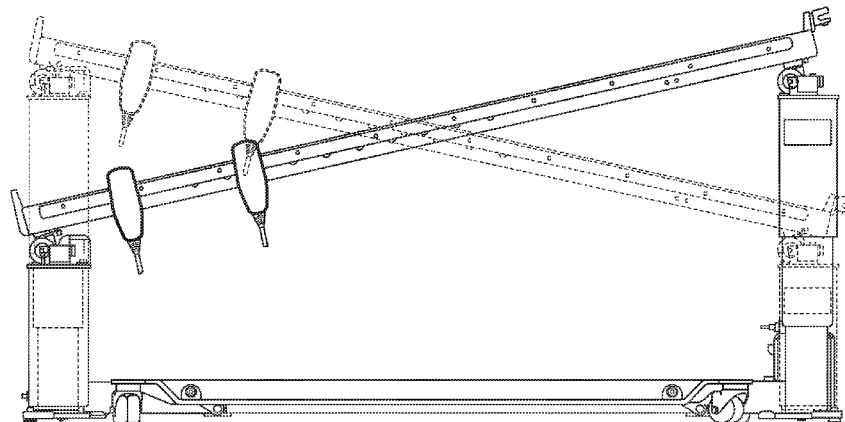
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(57) **ABSTRACT**

Surgical table and system for positioning, or lifting, a patient for purposes of generally performing a medical procedure on a posterior-portion of the patient (such as spinal surgery). The surgical table and system comprise a patient support system, a patient-positioning system and a base. In one embodiment, the patient-positioning system is configured to lift the head or foot end of the patient independently from each other, such as in Trendelenburg or reverse-Trendelenburg positions, and is also configured to angle the patient laterally. In another embodiment, the patient support is configured with an electrically-powered track and/or rail system that extends the patient support assembly away from the base, whereby the extension of the patient support forms a cantilevered support.

18 Claims, 13 Drawing Sheets



US 9,474,671 B2

Page 2

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- (56) **References Cited**
- U.S. PATENT DOCUMENTS
- | | | | | |
|-----------|------|---------|----------------|-------|
| 3,750,659 | A | 8/1973 | Loomans | |
| 3,827,089 | A | 8/1974 | Grow | |
| 4,029,089 | A | 6/1977 | Mulholland | |
| 4,296,761 | A | 10/1981 | Tyo | |
| D307,055 | S | 4/1990 | Johnston | |
| 4,937,901 | A | 7/1990 | Brennan | |
| 5,131,106 | A * | 7/1992 | Jackson | 5/613 |
| D347,604 | S | 6/1994 | Ernst et al. | |
| D356,527 | S | 3/1995 | Wohnsen et al. | |
| 5,489,258 | A | 2/1996 | Wohnsen et al. | |
| 5,618,055 | A | 4/1997 | Mulholland | |
| 5,903,940 | A * | 5/1999 | Volker et al. | 5/611 |
| 6,154,901 | A | 12/2000 | Carr | |
| 6,421,854 | B1 * | 7/2002 | Heimbrock | 5/610 |
| 6,526,610 | B1 | 3/2003 | Hand et al. | |
| 6,640,363 | B1 * | 11/2003 | Pattee et al. | 5/601 |
| 6,678,907 | B1 * | 1/2004 | Voelker et al. | 5/611 |
| 6,681,423 | B2 * | 1/2004 | Zachrisson | 5/610 |
| 6,941,951 | B2 | 9/2005 | Hubert et al. | |
| 7,036,512 | B2 | 5/2006 | Harnois | |
| 7,137,160 | B2 | 11/2006 | Hand et al. | |
| 7,152,261 | B2 * | 12/2006 | Jackson | 5/600 |
| 7,197,778 | B2 | 4/2007 | Sharps | |
| 7,272,866 | B1 * | 9/2007 | Bradovich | 5/601 |
| 7,343,635 | B2 * | 3/2008 | Jackson | 5/611 |
| 7,343,916 | B2 | 3/2008 | Biondo et al. | |
| 7,520,007 | B2 * | 4/2009 | Skriggs | 5/621 |
| 7,520,008 | B2 | 4/2009 | Wong et al. | |
- | | | | | |
|--------------|------|---------|-------------------|------------|
| 7,614,639 | B2 | 11/2009 | Tholkes et al. | |
| D612,942 | S | 3/2010 | Verdon-Roe | |
| 7,676,866 | B2 * | 3/2010 | Toms et al. | 5/611 |
| 7,739,762 | B2 * | 6/2010 | Lamb et al. | 5/618 |
| 8,056,163 | B2 * | 11/2011 | Lemire et al. | 5/611 |
| 8,424,133 | B1 * | 4/2013 | Rossi et al. | 5/601 |
| 2004/0172758 | A1 * | 9/2004 | Alakkat | 5/610 |
| 2005/0204472 | A1 * | 9/2005 | Gagneur et al. | 5/601 |
| 2006/0242765 | A1 | 11/2006 | Skriggs | |
| 2007/0000055 | A1 * | 1/2007 | Donaldson | 5/607 |
| 2007/0174966 | A1 | 8/2007 | Lopez-Sansalvador | |
| 2007/0192960 | A1 * | 8/2007 | Jackson | 5/618 |
| 2007/0251012 | A1 * | 11/2007 | Hill | 5/624 |
| 2008/0256709 | A1 * | 10/2008 | Weiler | 5/611 |
| 2009/0209844 | A1 * | 8/2009 | Gagnon et al. | 600/411 |
| 2009/0282614 | A1 * | 11/2009 | Jackson | 5/601 |
| 2010/0024128 | A1 * | 2/2010 | Skriggs | 5/621 |
| 2010/0192300 | A1 * | 8/2010 | Tannoury et al. | 5/607 |
| 2010/0223728 | A1 * | 9/2010 | Hutchison et al. | 5/610 |
| 2011/0099716 | A1 * | 5/2011 | Jackson | 5/607 |
| 2011/0107516 | A1 * | 5/2011 | Jackson et al. | 5/608 |
| 2012/0248331 | A1 * | 10/2012 | Iwata | 250/453.11 |
| 2013/0111666 | A1 * | 5/2013 | Jackson | 5/601 |
| 2013/0219623 | A1 * | 8/2013 | Jackson | 5/613 |
| 2013/0254992 | A1 * | 10/2013 | Jackson | 5/607 |
| 2013/0254993 | A1 * | 10/2013 | Jackson | 5/607 |
| 2013/0254994 | A1 * | 10/2013 | Jackson | 5/607 |
| 2013/0312181 | A1 * | 11/2013 | Jackson et al. | 5/601 |
| 2013/0312182 | A1 * | 11/2013 | Jackson et al. | 5/607 |
| 2013/0312188 | A1 * | 11/2013 | Jackson | 5/618 |
| 2014/0020179 | A1 * | 1/2014 | Brougham et al. | 5/601 |
| 2014/0020181 | A1 * | 1/2014 | Jackson | 5/607 |
| 2014/0208512 | A1 * | 7/2014 | Jackson | 5/608 |
- OTHER PUBLICATIONS
- “Radiolucent Wilson Frame”, Orthopedic Systems, Inc. (OSI), Poster, 1998, 1 page.
- * cited by examiner

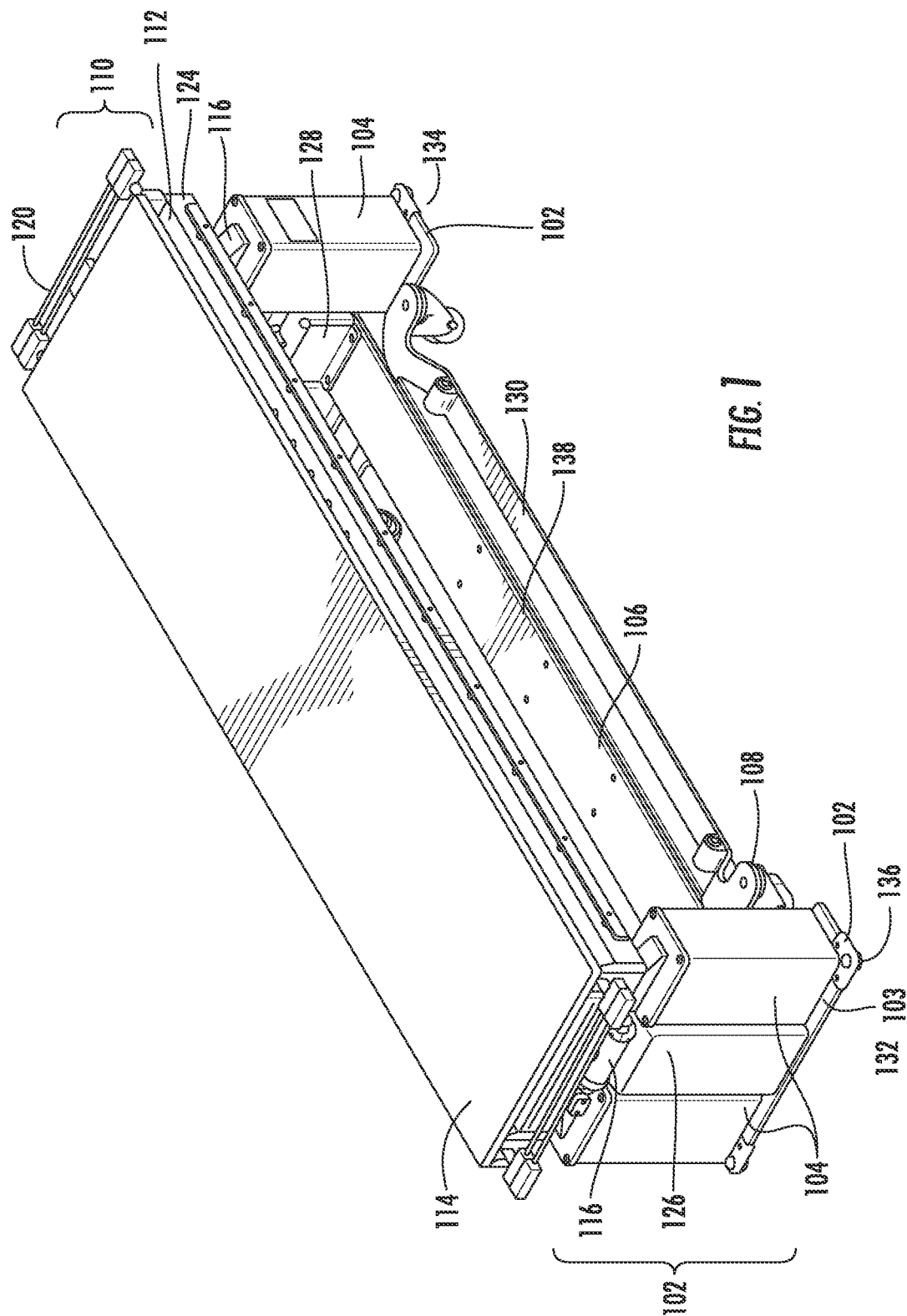


FIG. 2A

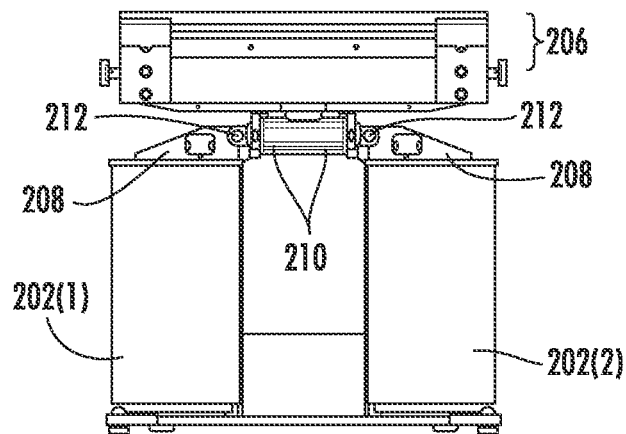


FIG. 2B

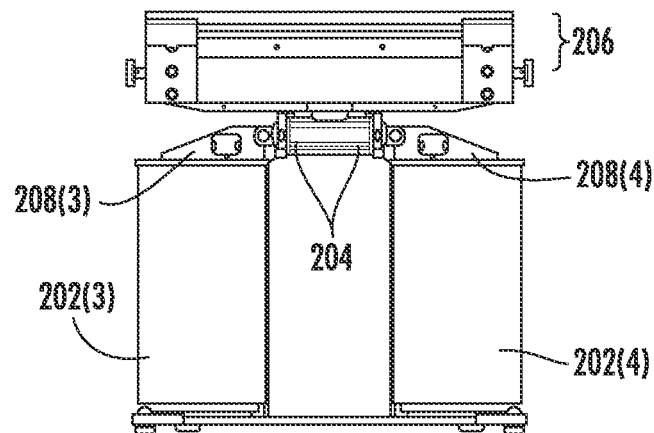
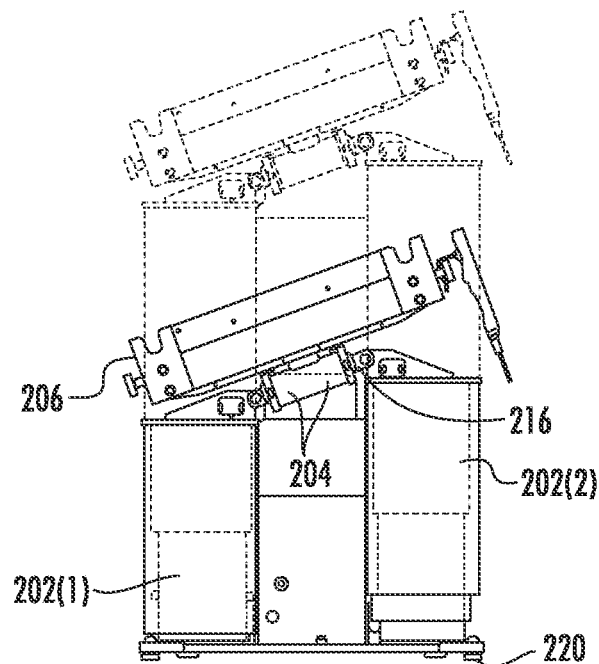


FIG. 2C



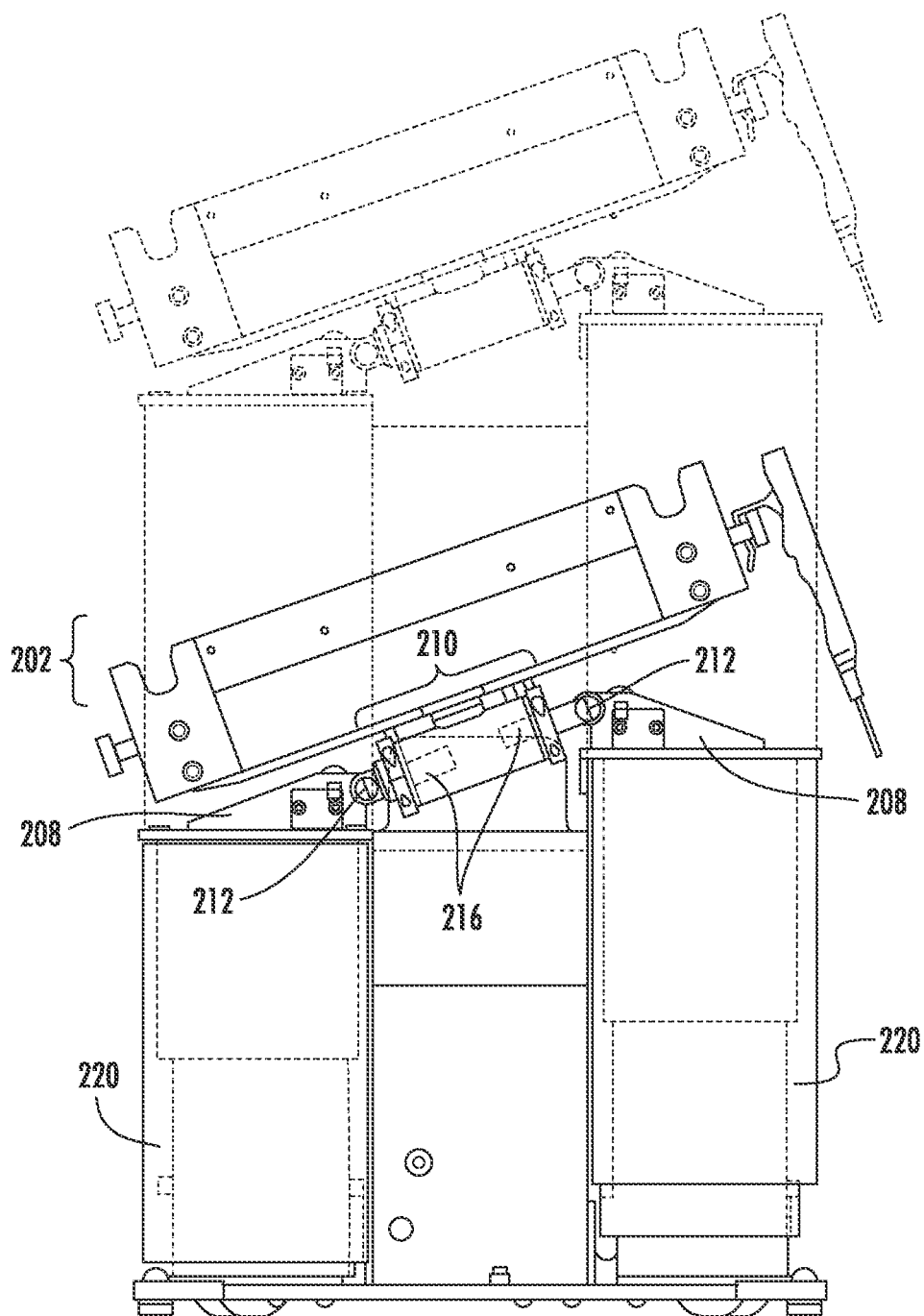


FIG. 2D

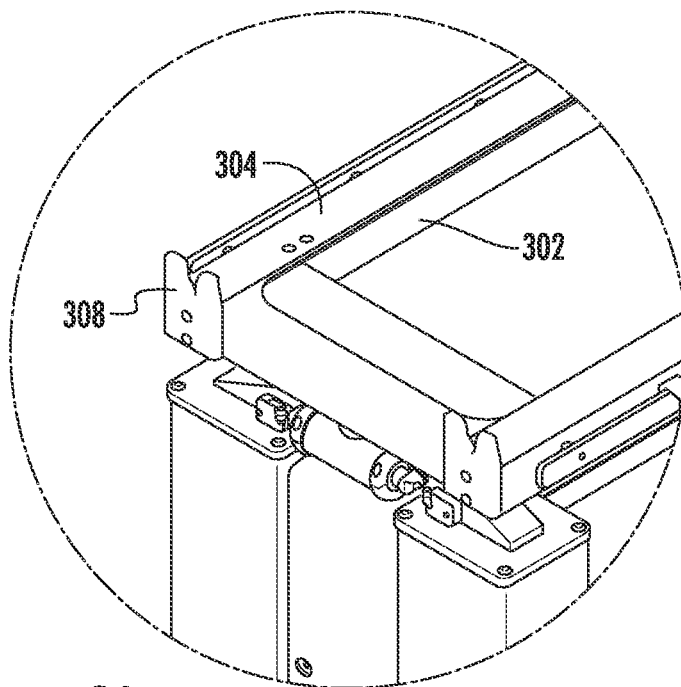


FIG. 3A

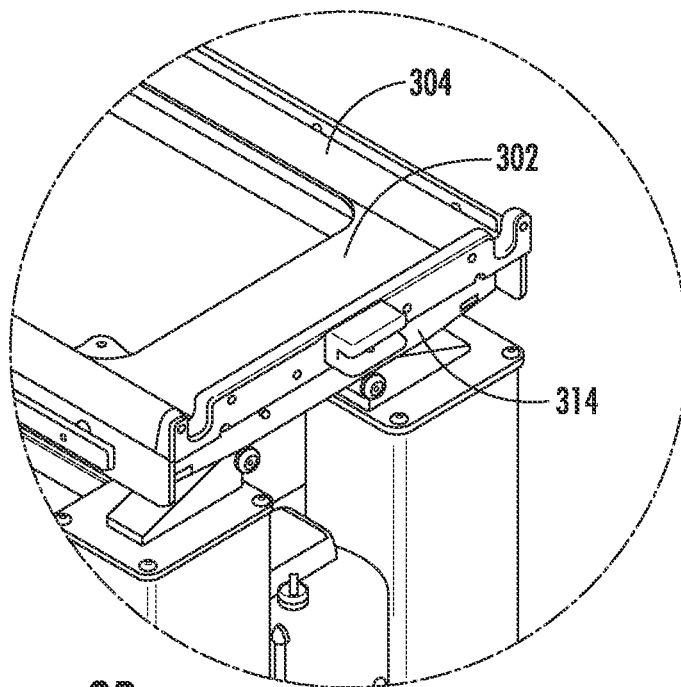
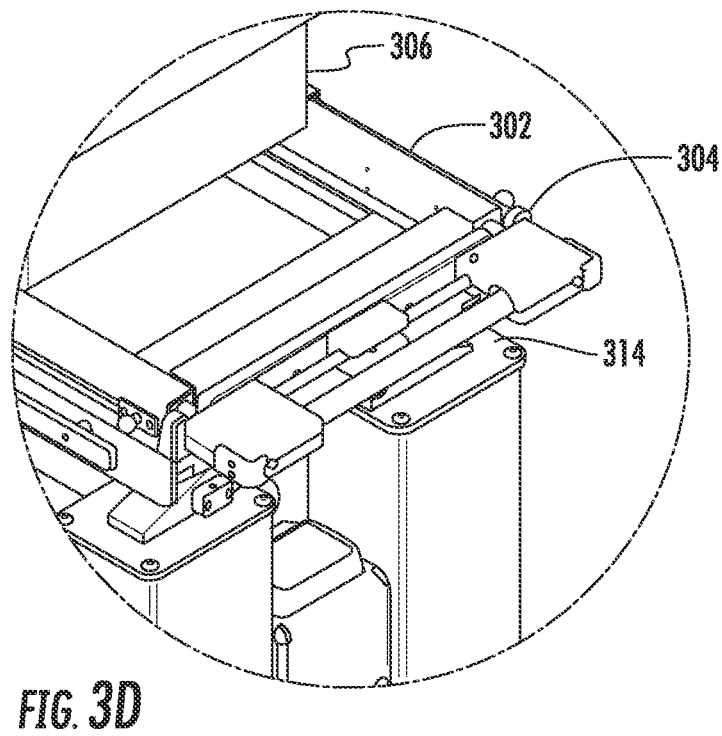
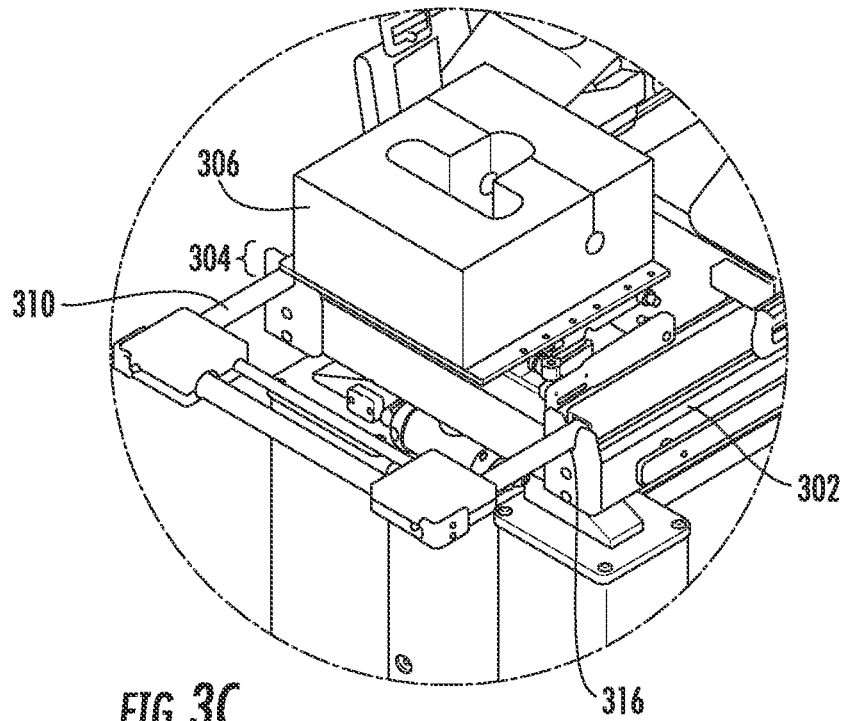


FIG. 3B



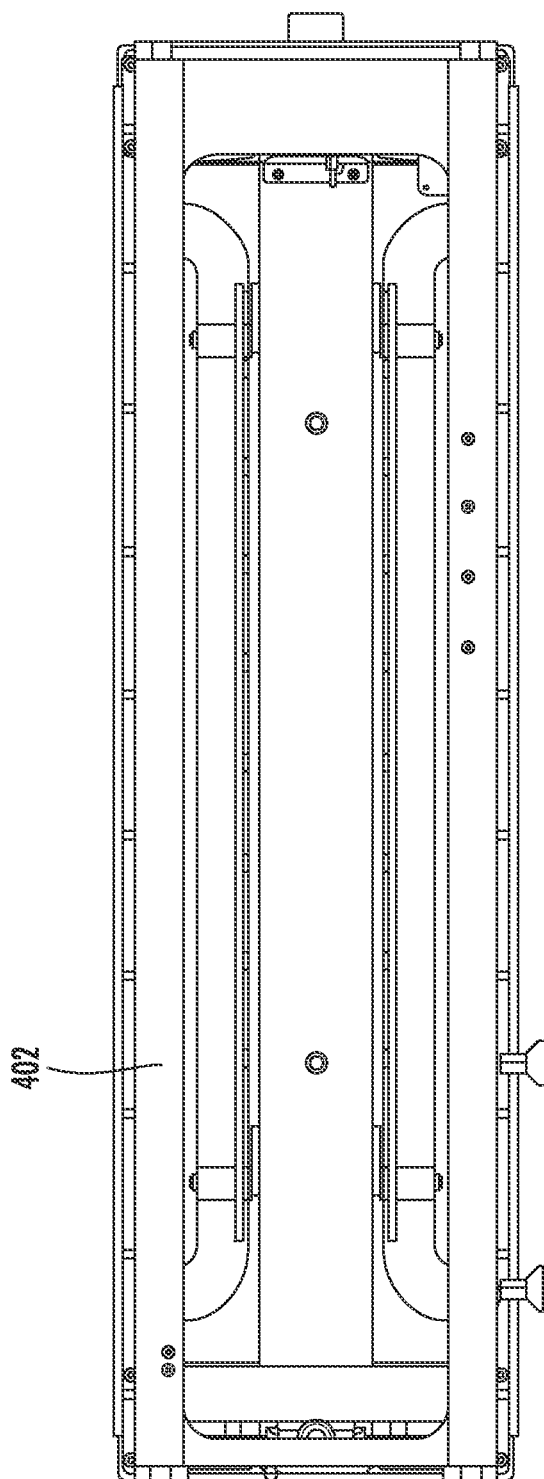
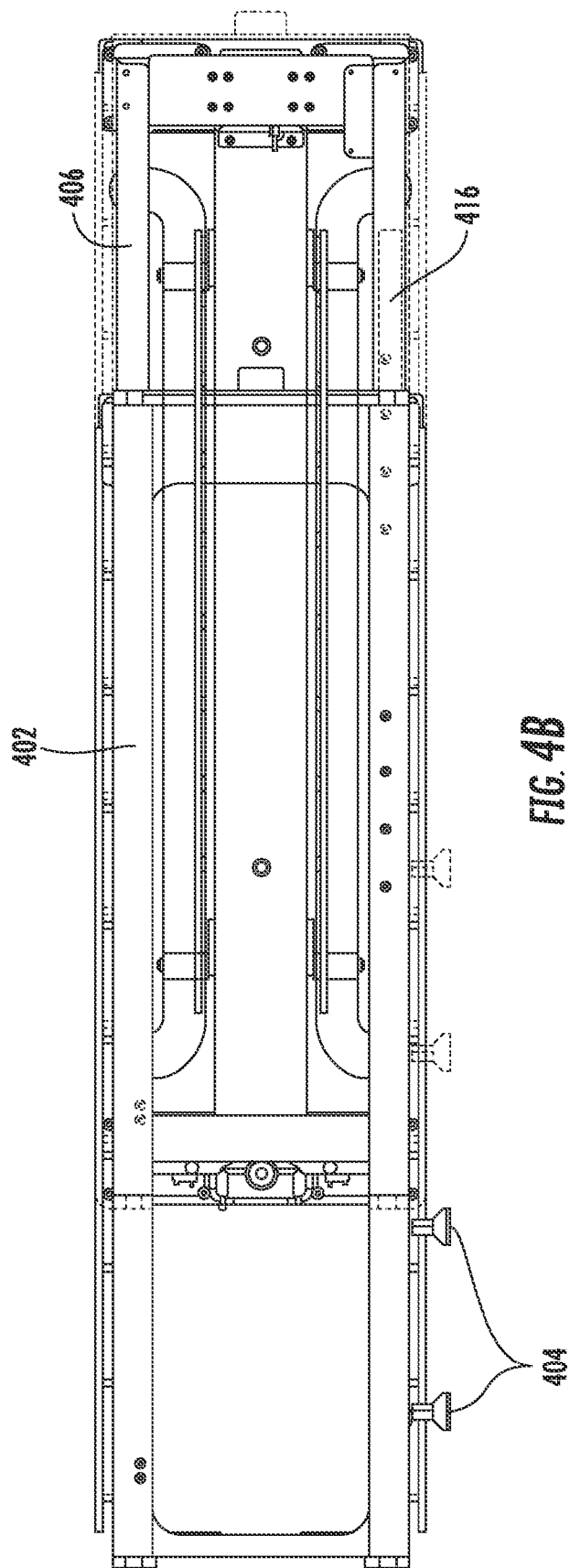


FIG. 4A



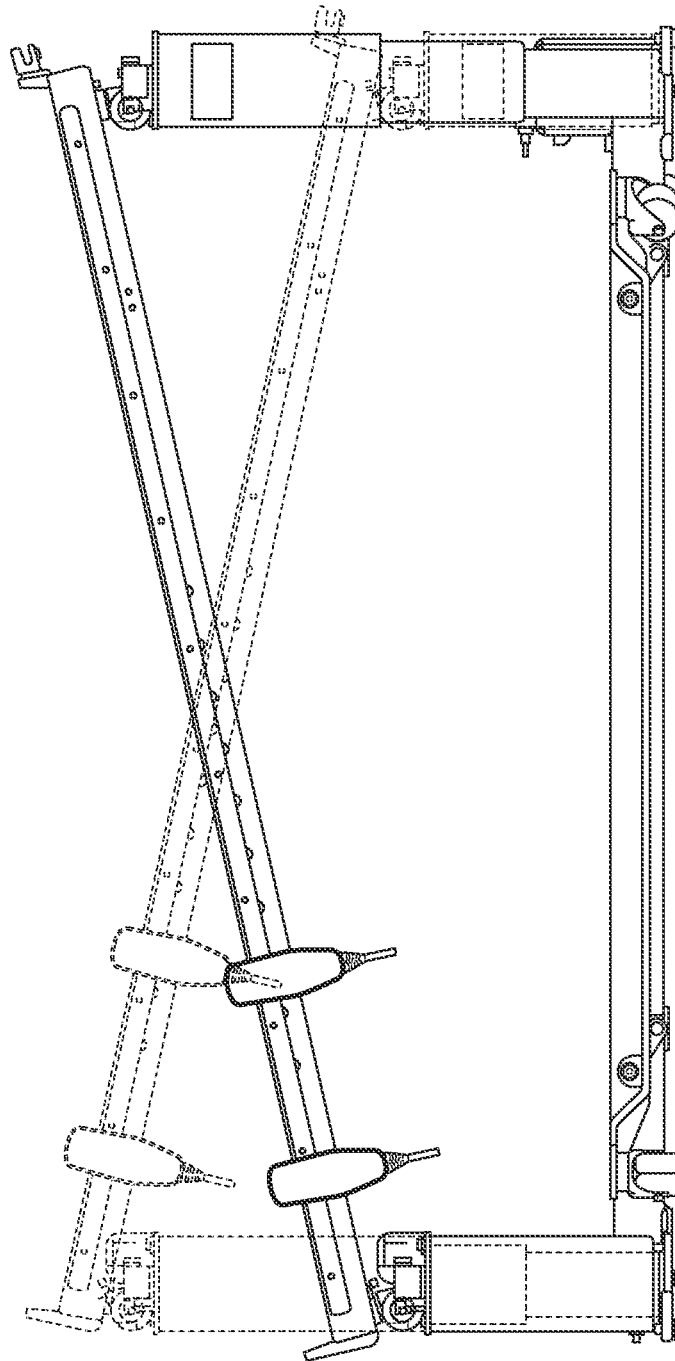


FIG. 5

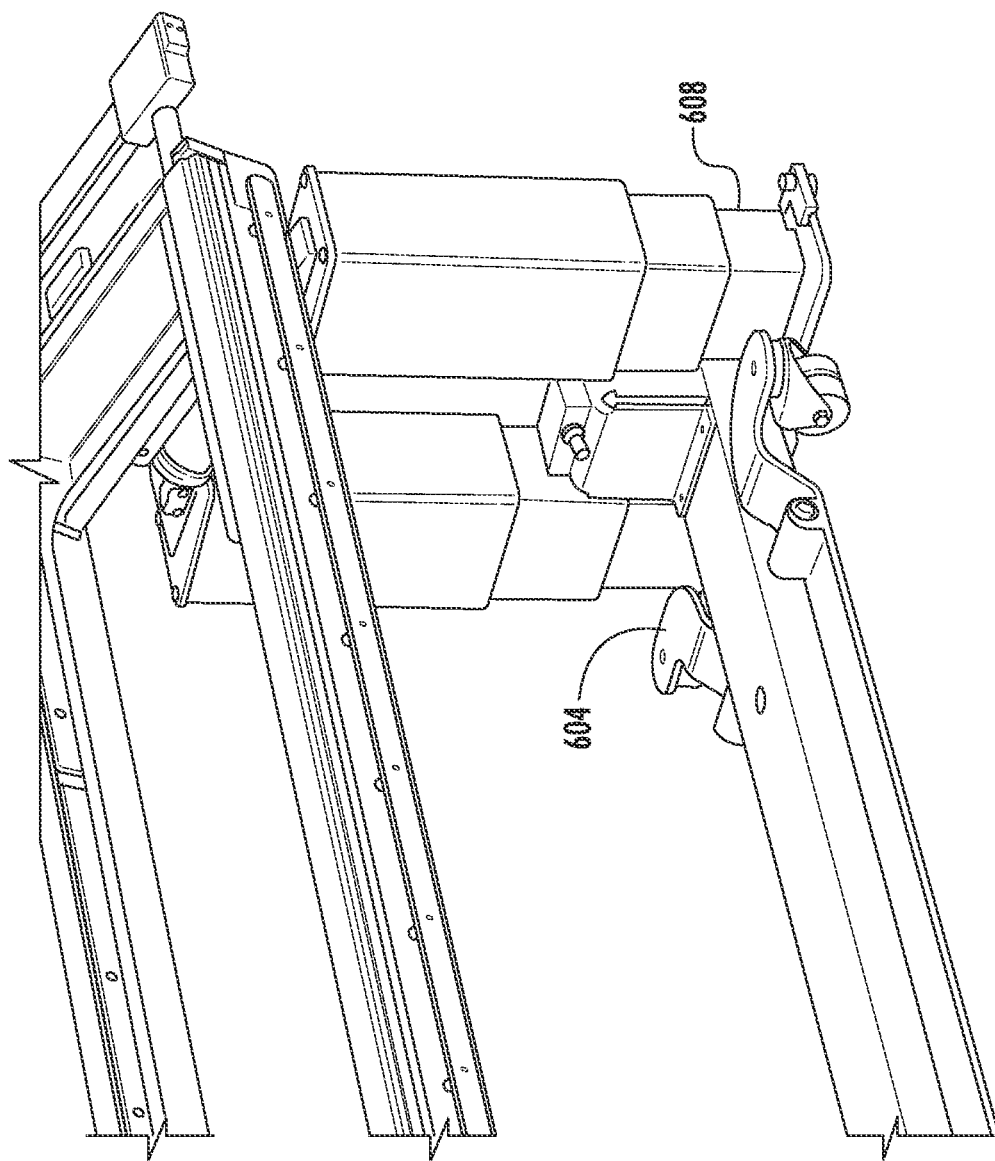


FIG. 6

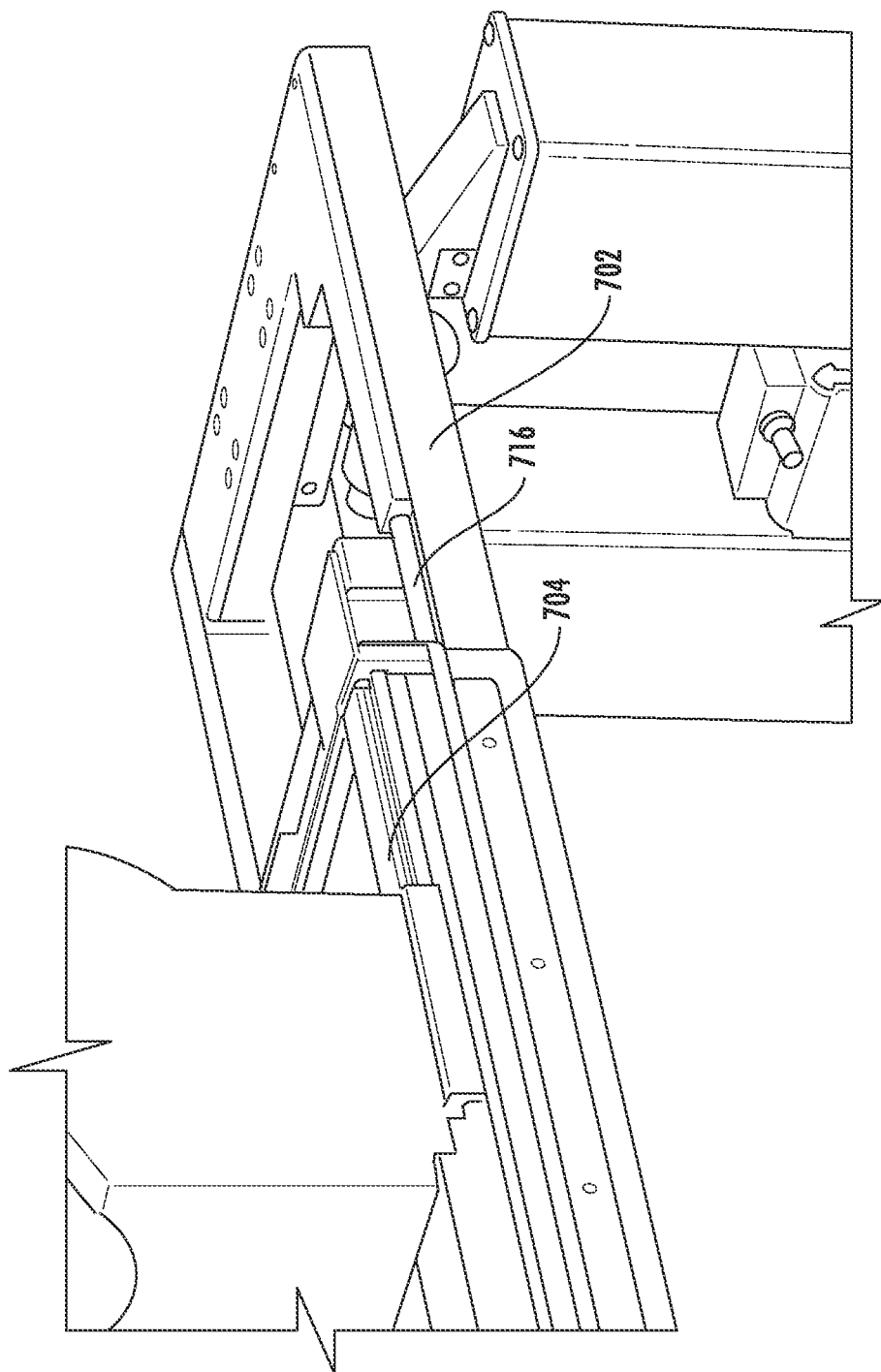


FIG. 7

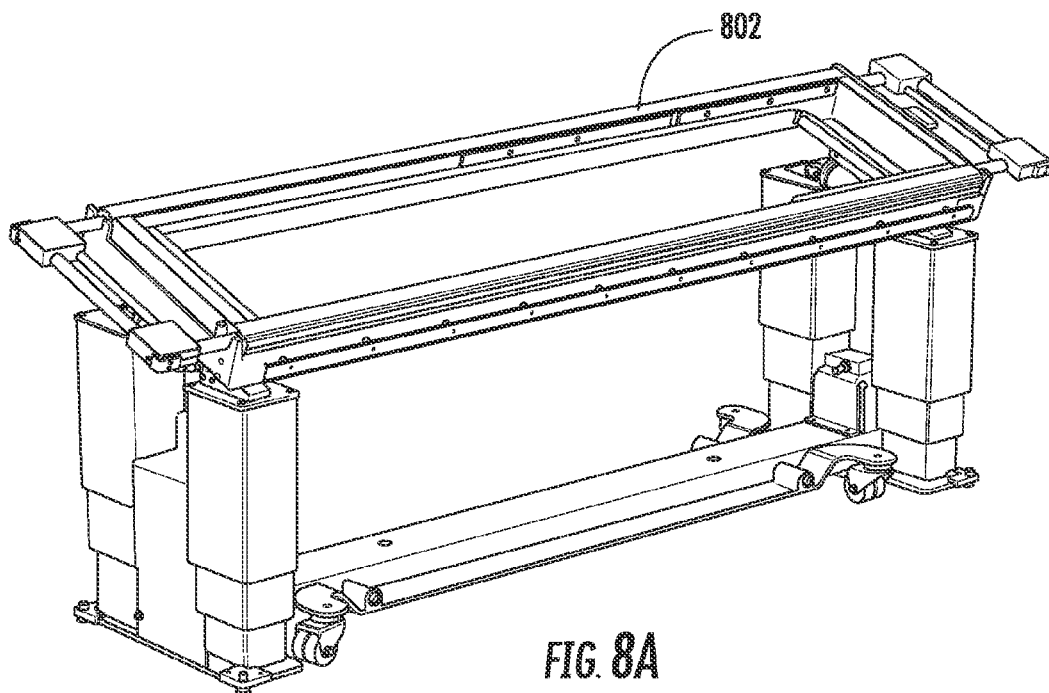


FIG. 8A

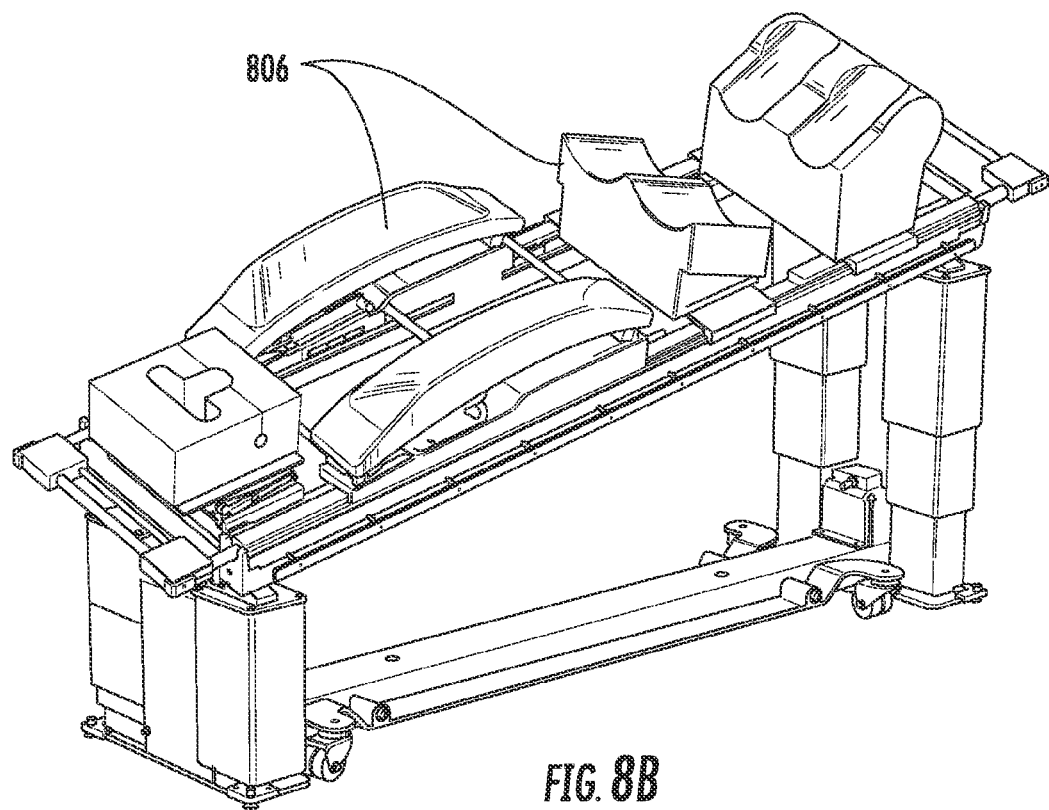
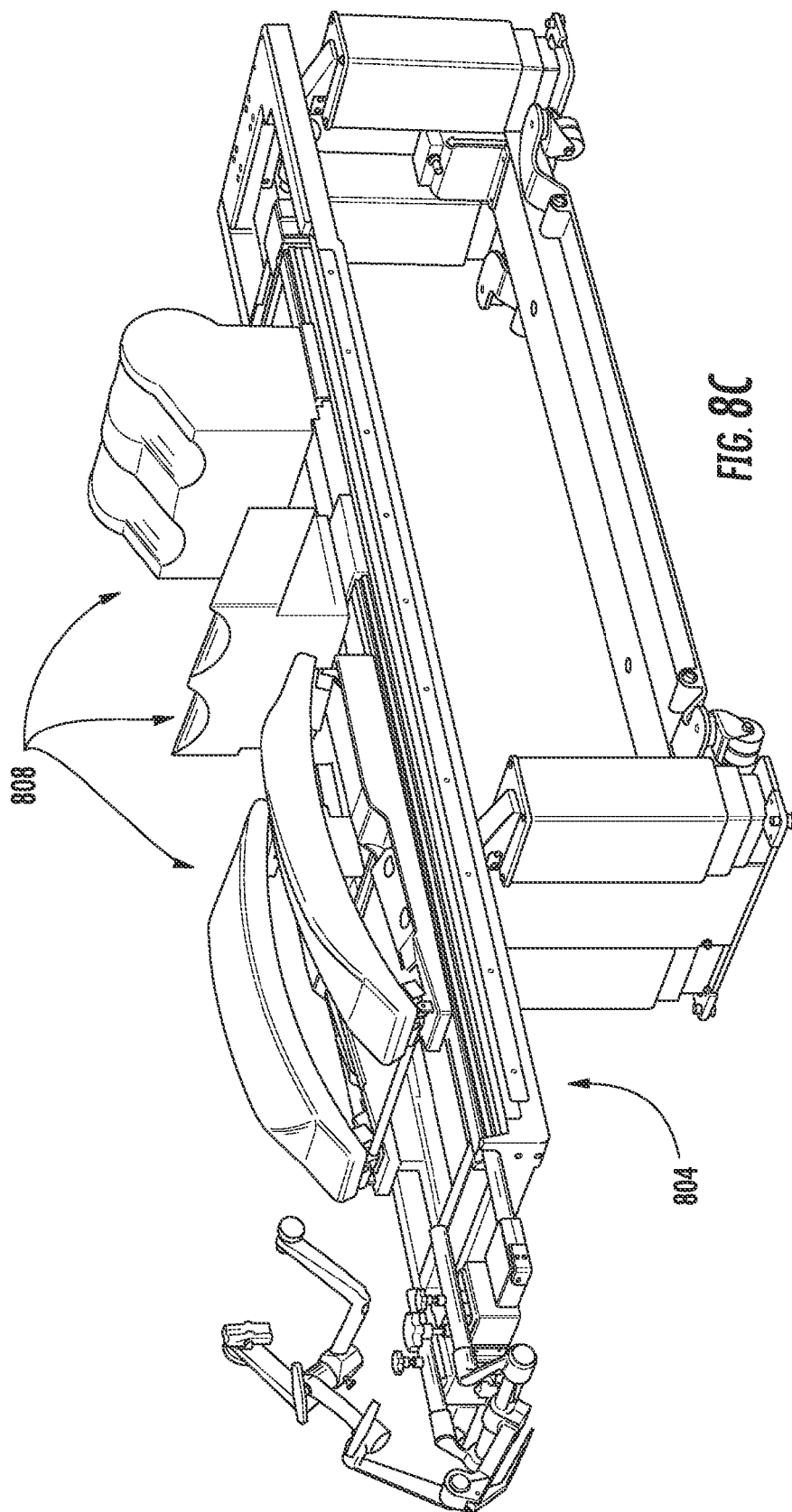


FIG. 8B



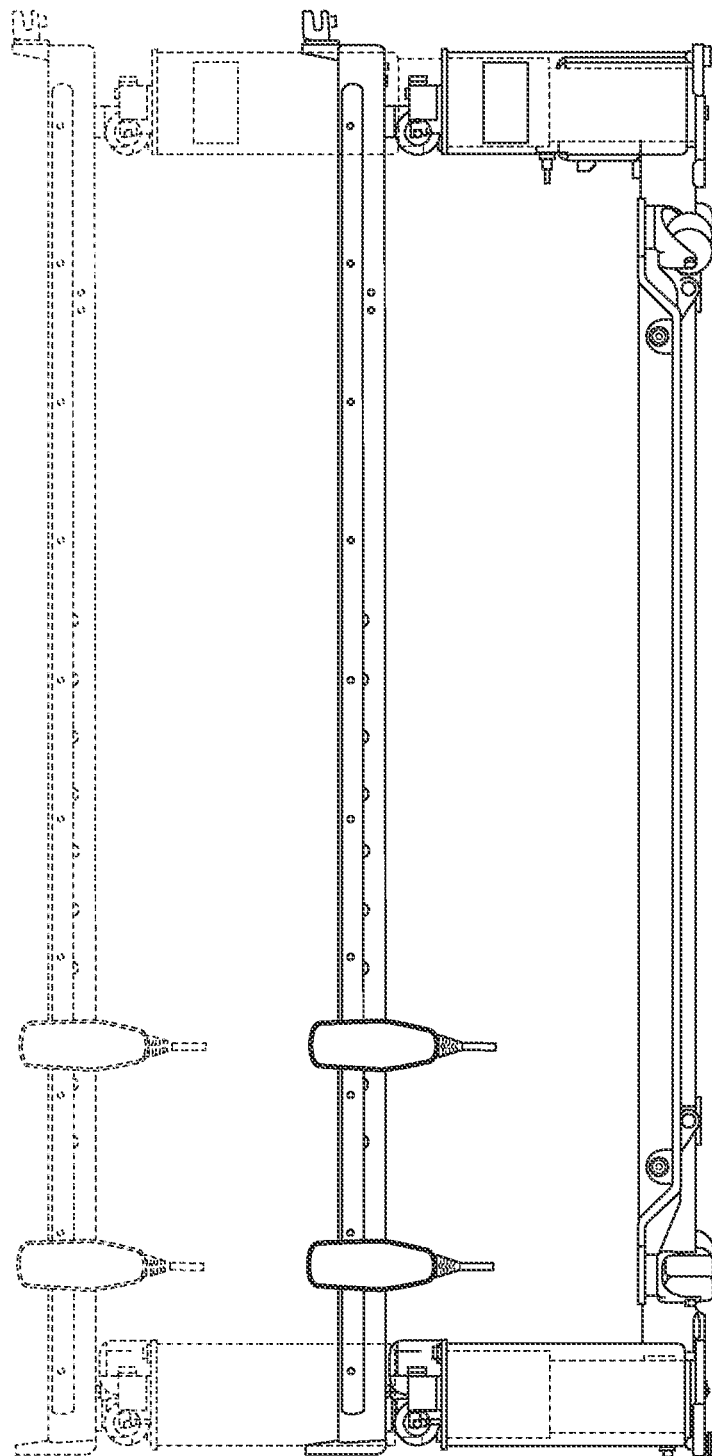


FIG. 9

1

SURGICAL TABLE**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of U.S. Provisional Patent Application No. 61/607,253, filed on Mar. 6, 2012, the contents of which are herein incorporated by reference.

FIELD OF ART

This patent application is directed to a device, apparatus and system for positioning or lifting a patient for purposes of generally performing a medical procedure or surgery.

BACKGROUND

Positioning of a patient is an important consideration in surgery. Generally, surgeries and procedures performed to the posterior of a patient require the patient to be positioned in a prone position to provide access to a surgical site. Much of the positioning must be accomplished manually. This manual procedure can dislodge wires, tubes or other elements of the patient-monitoring equipment that is used during surgery, thereby risking disruption of the monitoring of the patient's condition.

Still another complication associated with manually positioning a patient onto an operating table for back surgery involves positioning the patient in proper alignment on the table. Some patients are placed on a "Wilson Frame" to properly align the back and thereby enhancing proper ventilation. The Wilson Frame allows the abdomen to hang pendulous and free. It is often difficult to manually manipulate the patient once placed onto the operating table to ensure proper alignment with the Wilson Frame underneath the patient.

Current devices, such as the Wilson Frame, used in operating rooms for supporting patients in a prone position with the abdomen free are passive devices designed only to provide support to the patient's trunk on the operating table during the surgery. It has been demonstrated that such passive frames can provide some changes in spinal configuration by virtue of the gravity effect. There is also danger in an abrupt movement of the patient's knees during the spinal procedure. Whereas studies have shown it is more preferable to raise the patient's legs very gradually; however, manually raising the legs in a gradual manner is difficult.

Other ancillary problems involve positioning of the head, chest, and legs with proper support and access for devices such as the endo-tracheal tube. Anthropometric considerations, such as patient size, including weight and width, cause the operating staff to ensure that proper padding and elevations are used to support the head, chest, and legs. It is not uncommon to find operating staff stuffing pillows or bedding underneath a patient to adjust for different anthropometric features of a patient.

There are dedicated-back-surgery systems on the market on which a patient can be positioned during a diverse set of orthopedic trauma, thoracic, and spinal surgery procedures. These devices, however, tend to be complicated and cumbersome to operate, and often subject the patient and operating staff to risk or death. For example, certain tables that allow tilting, or positioning, of the patient employ T-pins, which must be manually engaged and/or disengaged in order to position the device. There have been recent patient accidents following inadvertent and unexpected tilting of devices due to T-pin malfunction as a result of operator error.

2

For instance, there are recent reports of injury-related incidents leading to product recalls of certain dedicated-back-surgery systems on the market today. A potential problem with these dedicated-back surgery systems is the potential for unexpected movement/tilting of the table, due to operator error of T-pin positioning.

Also, patients and the equipment on which the patient is lying can drop several feet unto the floor due to staff error and the lack of redundant safety features, resulting in serious injury or death to the patient and/or operating staff. Such unanticipated movement of the patient during surgery can lead to paralysis or other catastrophic injuries to both the patient and operating staff.

Accordingly, there remains a need for equipment that may more safely and efficiently facilitate the positioning of a patient during spinal surgery.

SUMMARY

Described herein are an apparatuses, including systems and several mechanical elements, assemblies and sub-systems, for positioning, raising, inclining, declining, or lifting a patient for purposes of performing a medical procedure.

In one example, a positioning system may include motorized-vertical-lift columns and a lateral-tilt assembly that adjustably position an upper portion of the table into a plurality of positions, including: Trendelenburg, reverse Trendelenburg, up, down, lateral tilt, combinations of the aforementioned, and auto-level positioning. In one example, a control unit and user interface panel allows a user to operate and control the position of an upper-portion table (with respect to the floor).

In another example, the apparatus includes a motorized cantilever, facilitating extension of an upper portion of the table beyond its base.

In another aspect, the lifting system includes lift columns that vertically extend or contract allowing for adjustability of the height of the table. The lift columns may extend or contract in tandem or individually, allowing the a patient resting on a surface of the table to be raised, lowered, tilted laterally (in tandem with the lateral-tilt assembly), placed in a neutral horizontal, inclined, or declined position.

In one embodiment, vertical-lift columns remain a fixed distance away from one another, each remaining generally perpendicular with respect to the floor. The table includes a base that may include a cross member, which joins the four vertical-lift columns.

In still another example, the surgical table may include a frame in the form of a platen for engagement and disengagement the table. The platen may include a single-unitary-patient support such as for supporting the patient in a supine position. The platen may also include one or more configurable and removable patient supports, such for supporting the patient in a prone, lateral, or particular supine positions. The platen may engage or disengaged from an upper portion of the table. The platen, patient-support surfaces and/or table may also include the ability to receive various equipment and devices attached thereto on as needed basis for specific-surgical procedures. Thus, table is modular allowing for different customized patient-support configurations and equipment for engagement to or disengagement therefrom.

Further details will become apparent with reference to the accompanying drawings and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a topside perspective view of one embodiment of the surgical table/patient-positioning apparatus, with a platen engaged with an interface.

3

FIG. 2A shows a front-end view of one embodiment of the patient-positioning apparatus, showing a cross coupler mounted to the top end of lift columns.

FIG. 2B shows a back-end view of one embodiment of the patient-positioning apparatus with a cross coupler mounted to the top end of lift columns.

FIG. 2C shows a front-end view of the positioning system in a lateral tilt. In a lateral tilt, a set of rods housed in the cross coupler are engaged in a push-pull action, thereby facilitating the tilt of the interface of the apparatus.

FIG. 2D shows an interior view of the cross coupler.

FIG. 3A shows a top-down perspective view of an interface at the head-end. In view are the receiving ends (shown as grooves) of the interface, where the patient support can snap into position.

FIG. 3B shows a top-down perspective view of a patient support assembly at the foot end, with a platen frame in position. A latch is also shown.

FIG. 3C shows a top-down perspective view of a patient support assembly at the head-end; a head support is attached to the interface.

FIG. 3D shows a top-down perspective view of a patient support assembly at the foot end.

FIG. 4A shows a top-down view of one embodiment of the patient support **402**, with the interface in the neutral position.

FIG. 4B shows a top-down view of one embodiment of the patient-support in the expanded—cantilever—position **404**. Also shown in dashed lines to represent the interior of the interface frame is a piston **416**, which powers the movement of the frame and/or platen **402** along the interface **406**.

FIG. 5 shows a side perspective view of one embodiment of the patient-positioning apparatus in the Trendelenburg/Reverse position.

FIG. 6 shows a partial view of the wheel system **604**, with the wheel partially engaged and extended away from the base **608** of the apparatus. When the wheels are fully engaged and extend downward into the floor, the base **608** of the apparatus is raised off the ground so that the apparatus is supported by the wheels **604**.

FIG. 7 shows a partial view of the piston **716** that powers the cantilever of the apparatus.

FIG. 8A shows a side view of the surgical table apparatus with the patient support platen **802** positioned in a lateral tilt.

FIG. 8B shows a side view of the surgical table apparatus equipped with various embodiments of patient supports **806** connected.

FIG. 8C shows a side view of the surgical table apparatus equipped with a Wilson frame-style support system **808**.

FIG. 9 shows a perspective view of the surgical apparatus in a lowered position (no extension of vertical lift columns) and extended position, with vertical lift columns in a fully-extended position.

DETAILED DESCRIPTION

Terminology:

The term “an embodiment,” “one embodiment” “example” or similar formulations, means that a particular feature, structure, operation, or characteristic described in connection with at least one embodiment or example. Thus, the appearances of such phrases or formulations are not necessarily all referring to the same embodiment or example. Furthermore, various particular features, structures, operations, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

4

The term “including” means “including but not limited to” unless the context requires otherwise.

The term “platen” means an assembly having a framework and a patient-support area disposed within an area defined by the framework. While specific examples may refer to one or the other, it should be appreciated by those skilled in the art, that either is interchangeable.

The term “prone” refers to a patient lying face downward.

The term “supine” refers to a patient lying face upward.

The term “Trendelenburg” refers to the Trendelenburg position, in which the body is laid flat on the back (supine position) with the feet higher than the head by 15-30 degrees, in contrast to the reverse-Trendelenburg position, where the body is tilted in the opposite direction. It is a term referring to a standard position used in surgery.

Overview of Surgical Table with Positioning System:

Described is an apparatus and system for supporting and positioning a patient for purposes of generally performing a medical procedure including spinal surgery. The application is also directed to modules for supporting different portions of a patient's body, while lying in a prone, supine or lateral position during a medical procedure. In one embodiment, the surgical table comprises a patient-support surface, an interface, and a positioning system.

In one embodiment, the apparatus includes a surgical table configured to provide unrestricted access to the patient by medical staff, including direct access to the patient's head and neck region for the ease and safety of anesthesiology and other patient-monitoring equipment. In another embodiment, an upper portion of the surgical table (i.e., generally furthest from the floor) can be adjusted to various positions including, a lateral roll, Trendelenburg, reverse Trendelenburg, or combination of lateral roll and Trendelenburg.

In yet another embodiment, the surgical table is height adjustable and capable of height adjustment. For instance, in one embodiment, the upper portion of the surgical table may be adjusted from a lowest height of about 20 inches to a maximum height about 45 inches measured from the ground inches from the floor.

Exemplary Surgical Table & Patient Positioning Apparatus

An example surgical table **100** is depicted in FIG. 1. Table **100** is generally rectangular in shape, and includes a base **102**. Base **102** includes vertical-lift assemblies **104** joined together by an I-shaped member **106**, which is essentially parallel with the floor. A central portion **138** of member **106** generally bisects table **100** extending longitudinally between a head end **132** and foot end **134** of table **108**.

Each pair of vertical-lift assemblies **104** are positioned at head end **132** or a foot end **134** of table **100**, respectively. Attached to member **106** are two pairs of wheels **108** located bilaterally on each side of cross member **106**, each pair of wheels **108** spaced apart from each other; toward head end **132** and foot end **134** of table **108**.

In one example, the wheels **108** extend or retract. When wheels **108** are fully extended and engaged they contact the floor, and a lowest portion **103** of base **102** (with respect to the ground) is raised from the floor, and table **100** is fully supported by wheels **108**. Conversely, when wheels **108** are retracted and disengaged (depicted in FIG. 6) from the floor, a lowest-portion **103** of base **102** of the table **100** rests on the floor thereby effectively anchoring table in a stationary position. As appreciated by those skilled in the art, rubber bumpers **136** or other-suitable friction inducing devices/materials may be fastened to a lowest-portion **103** of base **102**. For example, these bumpers **136** may reside underneath each corner of base **102**.

5

A stabilizing bar **130** on each side of cross member **106** connects wheels **108**. Stabilizing bar **130** maintains the position of wheels in a fixed direction with respect to each other when transitioning from engaging and disengaging the floor.

Patient support assembly **110** includes an interface **112** and a patient support **114**. Patient support assembly **110** provides a surface for receiving and positioning a patient for a medical procedure. As described in more detail below, the patient support assembly can be of various configurations depending on the desired position of the patient and the procedure to be performed. While a platen is shown in FIG. 1, other structural elements may be incorporated as part of the patient support **114** without. Interface **112** generally comprises a rectangular frame with a head end and a foot end, and optionally comprises a slidable track, or rail, system **124**. In one embodiment, the interface is configured with a track system **124** for facilitating movement of the patient support along the surface of the apparatus. Patient support assembly **110** is attached to the base by a pair of positioning assemblies **116**.

In one embodiment, a power unit **126** and control panel **128** are integrated into the base of the table, although other arrangements of the power unit and control panel are envisioned, such as auxiliary units.

Patient Support Assembly

Interface **112** is configured for with engagement means for reversible attachment of a patient support **114**. In one embodiment patient support **114** is secured to interface **112** by attachment means such as a latch or other locking system. In another embodiment, patient support **114** is secured to interface **112** through a magnetic connector system. In yet another embodiment, patient support **114** connects to interface **112** by a "snap and release" attachment system.

FIG. 1 shows patient support **114** as a single rectangular platen. In another embodiment, a platen may be comprised of longitudinally-expanding plates or articulated plates, or includes of a framework suitable for supporting individual patient support members (see FIGS. 8A, 8B and 8C for examples). In another embodiment, platens are generally planar and may be constructed of any suitable radiolucent material, such as carbon fiber, or any suitable non-radiolucent materials such as aluminum. In general, platen is generally commensurate in shape and length with an average operating room table surface. It will be appreciated by those skilled in the art that the length and width may vary depending on the implementation and the size of patients.

Patient Support Modules

Patient support **114** may include different interchangeable modules that can be connected in various ways with interface **112**, depending on the preference of the operating staff, size of the patient, and type of operation being performed. Thus, it is possible for operating staff to efficiently swap in or out different patient-support modules needed for a particular operation.

For example, occipital padding and a leg bolster may be placed on a planar surface of the platen to support the head and legs respectively when a patient lies on his back on the surface of the platen. Other patient-supports include as examples: a head-support assembly, a torso support, leg pads that support the patient while Lying in a prone position. Torso support and leg pads can be fastened to the platen, and can move Longitudinally to adjust for different sized patients. In one example, torso support consists of two pads in the general shape of Wilson-styled chest frame, which supports the outer portions of the side of patient. These pads extend from the upper thighs to the shoulders of a patient.

6

The height of the center portion of the torso support is adjustable by a manual or powered crank system. (See FIG. 8 For examples of patient supports.)

Wheel System

Adjustable casters or wheels, **108** attached to the cross member provide mobility to the surgical table. A pair of casters **108** is attached at each of the head end and foot end of the table base along the cross-support member, on each side of the cross-support member. The wheels of the casters are contained with the footprint of the table, and therefore out of the Line of movement by medical personnel.

When the casters **108** are engaged, they rotate out from the cross-support member to a position in which the wheels are in contact with the floor. As the casters **108** rotate out and away from the cross-support member and become flush with the floor, the base of the table is raised from the ground. The table is made portable and can then be wheeled-about as are other portable transport devices, such as a gurney.

In one embodiment, casters **108** are interconnected via a cross-bar comprising a shaft that is configured within the cross-support member and runs the length of the cross-support member. In one embodiment, the wheels/casters are interconnected for coordinated movement. Movement of the shaft of the cross-bar transfers movement in turn to the wheels.

In one embodiment, the casters **108** are controlled electronically, but can also be operated manually. A motorized break (not shown) locks and unlocks the wheels. A safety feature comprises a lockout feature. The safety feature is configured such that when the wheels are engaged, the function of the positioning assembly is locked in the neutral position, thereby preventing inadvertent tilting, cantilever, Trendelenburg movement of the table. Only when the wheels are in the resting position—or collapsed—will the table be permitted to move laterally, cantilever, Trendelenburg or reverse Trendelenburg. (Figs. show the wheels in the neutral and extended (engaged) position.)

An optional handle **120** is located at either, or both of, the head end or foot end of the interface. In one embodiment, the leveling system **122** comprising a pair of adjustable leveling feet underlies the lift assemblies of the base at each end. Each leveling foot is independently adjustable, such as by a screw mechanism, in order to level and thereby stabilize the table against the surface on which the table resides. In one embodiment, the table is configured with an auto-leveling feature, which automatically adjusts leveling feet until the table is in a level position against the surface on which it rests.

Various controls are provided to control the various functions of the table, such as lifting and positioning. In one embodiment, two hand-held controls, or handsets are provided. A first hand-held control, or handset, is positioned at the head end of the patient support assembly, for easy access by medical personnel such as anesthesiology personnel. A second hand-held control can remain in the sterile field for use throughout the surgical procedure. In another embodiment, a foot control is provided.

Patient-Positioning System:

In one embodiment, the surgical table comprises a patient-positioning system configured to lift and/or tilt the head or foot end of the patient independently from each other, such as in Trendelenburg or reverse-Trendelenburg positions, and is also configured to angle the patient laterally.

FIGS. 2A and 2B show a front-end and/or back-end view of a patient-positioning system **200** comprising a vertical-lift assembly **202** comprising vertical lift columns **202(1)**, **202(2)** coupled to a position assembly **204**. A patient positioning

system is located at each end—head end and foot end—of the surgical table. Vertical-lift assembly **202**, and embodiments described herein, are typically electrically-powered lift columns, but it is appreciated by those skilled in the art having the benefit of this disclosure, that these lift columns may be powered by any suitable means including but not limited to hydraulics and pneumatics. Vertical-lift assemblies **202** are located at distal ends of the cross-support member (cross-support member not shown in FIG. 2). In one embodiment, vertical-lift assemblies are columns configured to extend and retract vertically, via telescoping members aligned within the columns, allowing for adjustment in height. As the height of the column is adjusted, so is the height of the patient support assembly **206**. In one embodiment, the height of both vertical-lift columns **202(1)**, **202(2)** move in unison. Vertical-lift columns **202** may incorporate actuators (not shown) that telescopically expand and contract each column to control their height. In one example, the lift columns include four separate actuators that independently effect movement. Each actuator may operate to increase or decrease the height of each column in unison, or independently from each other, so as to provide various angled positioning of the patient support assembly **206**.

Each of the two positioning assemblies **204** interconnects the lift-columns **202** to the patient support assembly **206**. Each distal attachment end **208** of the positioning assembly **204** is securely fastened/mounted to the top of lift-columns **202** by suitable attachment means such as screws or bolts. A cross coupler **210** bridges each distal attachment end and in turn is attached to the interface of the patient support assembly **206** (attachment point not shown in FIG. 2). A cross coupler arrangement is positioned at the head end and foot end and is configured to couple the actuators to the lift columns together laterally at each end of the table.

Cross coupler **210** comprises a cylindrical member that houses one or more independent rods **216** that move (expand or compress) in response to adjustments in the lift-columns. In one embodiment, the rods **216** are attached to the attachment ends in a tire wire fashion, similar to an eye bolt or pin that is configured to pivot or rotate.

In one embodiment, lateral movement and rotation about a fixed pivot point **212**, in response to movement of the vertical lift columns occurs. For example, as a vertical lift column is raised, a compression force is exerted, causing the rods to push or pull, depending on which lift column is engaged. Thus, one rod may move downward and rotate around the pivot point **212** as a result of the upward force exerted by the lift-column. Shown in FIG. 2C is an end view of one embodiment of the patient positioning system **200** in a lateral tilt of approximately 19 degrees. While it is not shown in the figures, it should be understood that the positioning system **200** is configured for lateral movement to occur in both directions—right and left—and depends on the movement of the vertical lift columns. FIG. 2D shows an interior view of the cross coupler and the position of the rods **216** as the positioning system is engages. When a lifting column is raised one rod moves further out of the coupler housing, while the opposing moves further into the housing of the coupler. This motion results in directional lateral movement of the interface and/or patient support assembly. Patient Support Assembly:

The interface and patient support, when engaged, form a patient support assembly, shown in more detail in FIGS. 3 and 4. Turning to FIG. 3, the head end and foot end of interface **302** are shown in FIGS. 3A and 3B, respectively. The interface is comprised of a rigid frame, generally rectangular in shape, and being otherwise open to allow

access of the patient from beneath the interface. The interface **302** is optionally configured with a track and/or rail (slider) system **304** coextensive with the outer edge of the interface **302**. The track and/or rail system **304** allows longitudinal extension of the patient support assembly outward beyond the base of the table. FIGS. 3C and 3D, respectively, show another embodiment of the patient support assembly with patient support **306** engaged with the track and/or rail system **304**.

In one embodiment, the patient support **306** is configured with a frame, comprising extension tubes **310** that engage and nest in one or more tracks and/or rails, **308** of the track and/or rail system **304**. In one embodiment, the tracks are coextensive with the edges of the interface. The sliding mechanism, such as extension tubes **310**, of the patient support is moveably connected and married with the reciprocal track **308** of the interface, when the patient support is attached to the interface. The extension tubes **310** move to permit the overall length of the patient support to expand or contract.

FIG. 3 also shows a latch mechanism **314** for securing the patient support to the interface. In one embodiment, a latch assembly is located at each of the head end and foot end of the patient support assembly, however other latch arrangements can be configured, such as along the length of the support.

FIGS. 4A and 4B show the patient support assembly **402** in a stationary—or resting—position in which to receive a patient, and an outwardly extended—cantilever—position, whereby the extension of the patient support assembly **402** forms a cantilevered support **404**. In one embodiment, the interface is configured with a linear actuator, such as a piston, shown in FIG. 4B. When engaged, the actuator facilitates movement of the patient support along the surface of the interface outward, away from the base of the table. In one embodiment, the interface can be extended from inches, up to two feet beyond the base of the table.

FIG. 5 shows example angled-positions of the patient support. As depicted in FIG. 5, the surgical table can provide movement of the patient in any combination of lateral and vertical angles generally required for procedures or other medical reasons, such as

Trendelenburg or Reverse-Trendelenburg.

Because the lifting mechanism of the table does not require use of lifting towers, there is unobstructed access to a patient's head, such as for administering anesthesia. Additionally, the table unit includes unobstructed-C-arm-access spacing for imaging.

Overall, in one embodiment, the surgical table configured to be raised to a height up to 38 inches from the floor, from a resting position of approximately 22 inches from the floor, as shown in FIG. 9. These heights correspond to heights useful for medical procedures, but other minimum and maximum heights can be achieved.

Further, because the surgical table does not require rotational equipment for securing the lifting platens, the unit is generally more stable and resistive to vibration, shaking, and undesirable sudden movement during sensitive operations that can be catastrophic to the patient.

One or more safety belt system (not shown) is used to safely restrain a patient to the patient support. The arrangement and number of safety belt systems will depend on the arrangement of the patient support members, and the position of the patient. In one embodiment, the safety belt system is configured to attach to the patient support by means of a Latch or groove.

In one embodiment, the apparatus is configured with one or more safety systems to prevent inadvertent movement of the positioning assembly or the Lift-columns. In another embodiment, the apparatus is configured with a "lock-out" device that disengages all functional aspects of the table if elements are not properly aligned or in the proper position. The apparatus can also be configured with an alarm system that activates when a system malfunctions or when the system is not in proper alignment. The warning can be visual or audible, or a combination.

In one embodiment, accessories may be connected to the patient support assembly. For example, a traction device may be connected to a tube or rail system located at either head or foot end of the patient support assembly, or to the head or rear end of the interface. More specifically, a pulley-style system can be connected to the patient support system via a clamp, or other attachment means, such as a latch.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the subjoined Claims and their equivalents.

What is claimed is:

1. An apparatus for positioning a patient for a surgical procedure, comprising:

a base comprising two pairs of vertical lifting-columns each having a top end and a bottom end, and a first-caster pair and second-caster pair each positioned adjacent to a respective one of the two pairs of vertical lifting-columns;

a patient-positioning system coupled to the top end of each pair of vertical lifting-columns; and

a patient-support assembly comprising an operating platform including a head end and a foot end and coupled to the patient-positioning system, the operating platform having lateral and longitudinal outer edges defining a generally rectangular area, wherein the patient-positioning system connects the patient-support assembly to the vertical lifting-columns, thereby permitting horizontal and lateral adjustment of the patient support assembly, the two pairs of vertical lifting-columns are positioned substantially within the generally rectangular area and are each confined within the longitudinal outer edges of the operating platform, and the first-caster pair and the second-caster pair are each confined within the generally rectangular area and are each confined longitudinally inward from the two pairs of vertical lifting-columns.

2. The base of claim 1, comprising: a cross-support member with distal ends comprising a head end and a foot end, whereby the head end and the foot end each are joined to a pair of vertical lift columns.

3. The apparatus of claim 1, whereby the casters are interconnected by a stabilizing bar that permits unified and synchronized movement of the casters.

4. The apparatus of claim 1, wherein the vertical lifting columns are electrically powered.

5. The patient support assembly of claim 1, comprising an interface and a patient support.

6. The patient support assembly of claim 5, whereby the assembly is configured with a track/and or rail system integrated within the edges of the interface and patient support, wherein the tracks and/or rails permit differently configured support members to be attached thereto.

7. The patient support assembly of claim 5, whereby the assembly is configured with a motorized track/and or rail system integrated within the assembly, thereby permitting movement of the patient support outward and away from the base in a cantilever configuration.

8. The apparatus of claim 1, further comprising a control panel and a power source.

9. The apparatus of claim 1, further comprising a hand-held remote control device, thereby permitting remote control of the vertical lift columns and positioning system.

10. The patient support assembly of claim 1, comprising an interface comprised of a hollow-out rectangular frame, which permits open access to a patient from the underside of the interface.

11. A surgical table, comprising:

a base comprising two pairs of vertical lifting-columns having a top end and a bottom end, and a first-caster pair and second-caster pair each positioned adjacent to a respective one of the two pairs of vertical lifting-columns;

a patient-positioning system coupled to the top end of each pair of vertical lifting-columns;

a patient-support assembly for receiving a patient, comprising an operating platform including a head end and a foot end and coupled to the patient positioning system, the operating platform having lateral and longitudinal outer edges defining a generally rectangular area, wherein the patient-positioning system connects the patient-support assembly to the lifting-columns, the two pairs of vertical lifting-columns are positioned substantially within the generally rectangular area and are each confined within the longitudinal outer edges of the operating platform, and the first-caster pair and the second-caster pair are each confined within the generally rectangular area and are each confined longitudinally inward from the two pairs of vertical lifting-columns.

12. The surgical table of claim 11, wherein the patient-positioning system is configured to lift the head or foot end of the patient independently from each other, and configured to angle the patient laterally.

13. The surgical table of claim 11, wherein the table is configured for height adjustment of the operating platform from a distance approximately 22 inches from the floor on which the table resides, to a distance 38 inches from the floor on which the table resides.

14. The patient support assembly of claim 11, comprising an interconnected interface.

15. The surgical table of claim 11, further comprising a power supply and control panel.

16. The surgical table of claim 11, further comprising a pair of hand-held remote controls for remote operation of the table.

17. The patient support of claim 11 comprising a track and/or rail system whereby the track and/or rail system is motorized, thereby facilitating extension of the surface of the patient support beyond a base of the table.

18. The surgical table of claim 11, further comprising a safety feature configured to disengage or prevent movement in order to prevent inadvertent rotation or lifting of the patient support.